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Electric battery powered industrial trucks [TED 22:  
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**IS : 8790 ( Part II ) - 1978**

( Reaffirmed 1996 )

## *Indian Standard*

# **GENERAL REQUIREMENTS OF POWERED INDUSTRIAL TRUCKS WORKING IN HAZARDOUS AREAS**

## **PART II ELECTRIC-BATTERY-POWERED INDUSTRIAL TRUCKS**

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

*Indian Standard***GENERAL REQUIREMENTS OF  
POWERED INDUSTRIAL TRUCKS WORKING  
IN HAZARDOUS AREAS****PART II ELECTRIC-BATTERY-POWERED  
INDUSTRIAL TRUCKS**

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# *Indian Standard*

## GENERAL REQUIREMENTS OF POWERED INDUSTRIAL TRUCKS WORKING IN HAZARDOUS AREAS

### PART II ELECTRIC-BATTERY-POWERED INDUSTRIAL TRUCKS

#### 0. FOREWORD

**0.1** This Indian Standard (Part II) was adopted by the Indian Standards Institution on 31 May 1978, after the draft finalized by the Industrial Trucks Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

**0.2** Safety in industrial operations is of extreme importance in order to avoid loss of human life or equipment and as incentive to the workmen involved in these operations. As more and more industrial trucks are used for load movement in industries with potentially hazardous atmospheres there is a need for guidelines for the economization in risks involved not only in the design and manufacture or conversion of trucks, but also for their operation and maintenance. It is difficult to make all areas absolutely free of hazardous atmosphere but it is possible and may be more economical to devise means to ensure a safe operation for the industrial trucks in hazardous atmospheres.

**0.3** Industrial trucks may be powered with an electric battery or internal combustion engine. Therefore this standard is issued in the following two parts:

- a) Part I Internal combustion engine-powered trucks, and
- b) Part II Electric-battery-powered industrial trucks.

**0.4** The areas where the hazardous handling operation occur can be identified with the works and stores dealing with explosives and petroleum based products, motor spirits, plastics, petro-chemicals, paints, cosmetics, LPG, besides oil refineries, airport refilling zones, oil and gas exploration and production rigs, artificial fibre plants, dye works, fertilizer plants, mines and many chemical works.

**0.5** The hazard factor in terms of fire and/or explosives risk to the personnel and property depends upon the presence of air/gas, vapour or powder mixture present in critical proportion which, if ignited by hot surface, hot gases, flame or sparks could cause an explosion or conflagration.

**0.6** The question of truck operation in hazardous environment must go farther than the approved designs of the machine. The safety of the total environment must be considered, namely, air circulation, ventilation, layout, types of flooring, presence of ramps and other equipment, etc, as also the question of maintaining the flame-proofed trucks.

**0.7** Efforts have been made to ensure provision of the legislation in safety in the operation of industrial trucks in the hazardous areas as applicable to individual industries. No comprehensive guidelines have been in existence.

**0.8** Wherever any requirement has been stipulated by statutory order, the same shall prevail over the requirement under this standard.

**0.9** In the preparation of this standard, assistance has been derived from the following:

BS CP 1003 : Part I : 1964 Electrical apparatus and associated equipment for use in explosive atmospheres of gas or vapour other than mining applications, Part I Choice, installation and maintenance of flame-proof and intrinsically-safe equipment. British Standards Institution, UK.

ANSI B56.4-1972 Standard for safety industrial trucks, internal combustion engine-powered. Underwriters' Laboratories, USA.

NFPA 505-1975 Fire safety standard for powered industrial trucks, including type designations and areas of use. National Fire Protection Association, USA.

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## **1. SCOPE**

**1.1** This standard ( Part II ) covers fire, electric-shock, and explosion-hazard aspects of electric-battery-powered industrial trucks.

**1.1.1** This standard does not cover other possible hazard aspects of such equipment.

## **2. TERMINOLOGY**

**2.0** For the purpose of this standard the following definitions shall apply.

**2.1 Hazardous Atmosphere** — An atmosphere containing any flammable gas or vapour in a concentration capable of ignition.

**2.2 Hazardous Area** — An area where during normal operations, a hazardous atmosphere is likely to occur in sufficient quantity to constitute a hazard.



**2.3 Remotely Hazardous Area** — An area, excluding an oil field, in which any flammable liquid, gas or vapour although processed, handled or stored, is so well under conditions of control that its liability to produce a hazardous atmosphere in sufficient quantity to constitute a hazard is only likely to occur under abnormal conditions.

**2.4 Safe Atmosphere** — An atmosphere not falling within the definition of hazardous atmosphere and incapable of ignition.

**2.5 Safe Area** — An area no part of which lies within either a hazardous area or remotely hazardous area.

### 3. IDENTIFICATION OF ELECTRIC TRUCKS

**3.0** For the purpose of this standard the industrial trucks shall be designated as under, depending upon the type.

**3.1** Electric-battery-powered industrial trucks are designated by the initial letter 'E' and are powered by batteries supplying 150 V or less.

**3.1.1 Type E** — Electric-battery-powered industrial trucks having minimum acceptable safety guards.

**3.1.2 Type EE** — Electric-battery-powered industrial trucks provided with safeguards in addition to those required for Type E electric trucks.

**3.1.3 Type EX** — Electric-battery-powered industrial trucks for hazardous locations in Zone 0.

### 4. CLASSIFICATION OF HAZARDOUS AREAS

**4.1** In determining the risk of fire or explosion from the presence of flammable liquids, gases or vapours, the zones with such characteristics have been divided into the following three categories according to the degree of probability of the presence of hazardous atmosphere.

#### 4.1.1 Zone 0 Areas

**4.1.1.1** An area in which hazardous atmosphere is continuously present shall fall under this category. This classification is applicable only where it is expected that a hazardous atmosphere will exist continuously. The statistical average duration for which the hazardous atmosphere is present is more than 1 000 hours per annum.

**4.1.1.2** Since a hazardous atmosphere exists continuously, any failure of electrical apparatus installed in a Zone 0 area would almost certainly lead to fire or explosion. Therefore, any installed electrical apparatus shall afford a degree of protection as near as practicable to the absolute.

**4.1.2 Zone 1 Areas** — An area in which a hazardous atmosphere is likely to occur under normal operating conditions shall fall under this category. This classification is applied to areas in which a hazardous atmosphere is likely to occur at any time, and which, therefore, require the fullest practicable application of measures to prevent the occurrence of a hazardous condition at any time and in any circumstances. The statistical average duration for which the hazardous atmosphere is present is between 10 hours and 1 000 hours per annum.

**4.1.3 Zone 2 Areas** — An area in which a hazardous atmosphere is likely to occur only under abnormal operating conditions shall fall under this category. This classification is applicable only where a fire or explosion hazard is unlikely and may be caused only by the simultaneous and improbably occurrence or an arc or spark resulting from an electrical failure and a hazardous atmosphere arising through failure of the conditions of control. It presupposes that any hazardous atmosphere resulting from an abnormal occurrence is rapidly dispersed so that possible contact with the electrical apparatus is of minimum duration. Any situation which allows a hazardous atmosphere to collect, such as pit or trench, although, it may be in the open air, shall in itself be classified as Zone 1 area, even though the surrounding area is classified as Zone 2. The statistical average duration for which the hazardous atmosphere is present is less than 10 hours per annum.

**4.2** The three basic conditions which are to be satisfied for the occurrence of fire or explosion are as under:

- a) Presence in sufficient quantity of a flammable gas or vapour;
- b) Mixing of the flammable gas or vapour with air or oxygen in proportions required to produce an explosive or ignitable mixture; and
- c) Occurrence of ignition.

**4.2.1** In applying this principle to any potential hazard, the quantity of the substance that might be liberated, its physical characteristics and the natural tendency of vapours to disperse in the atmosphere shall be recognized.

## **5. TYPE E INDUSTRIAL ELECTRIC TRUCKS**

### **5.1 Construction**

**5.1.1 General** — A Type E industrial electric truck shall comply with the following requirements.

**5.1.1.1** All wiring and other current-carrying parts of an industrial electric truck shall be so constructed and enclosed as to protect them from physical injury and to resist the abuses to which they may be subjected.

**5.1.1.2** Except as specified in **5.1.4.7** all electrical parts, including wiring, shall be mounted within the body of the truck.

**5.1.1.3** Contactors and fuses shall be so located as to be readily accessible for servicing, such as complete replacement or the replacement of contacts and inspection after the removal of cover or covers. Other arcing and operating parts shall be accessible for servicing and inspection.

**5.1.1.4** No uninsulated current-carrying part shall be exposed on the outer surface of the truck.

**5.1.1.5** A gasket employed between a cover and a box shall be cemented or otherwise secured to one of the gasketed surfaces.

**5.1.1.6** A drip pan shall not permit the collection of oil.

**5.1.1.7** A current-carrying part of the power circuit, other than a resistor, shall be of nonferrous metal, except as covered in **5.1.4.14**. Ferrous metal may be used for a resistor terminal in the power circuit and for all parts of the lighting, warning-signal, and other auxiliary and motor-control circuits. Steel, other than stainless, shall be zinc-coated, cadmium-plated, or equivalently protected against corrosion.

### **5.1.2 *Motors and Resistors***

**5.1.2.1** Unless they are enclosed, power-circuit resistors shall be located to provide free air circulation about the resistance elements. Power-circuit resistors shall be installed so as to minimize the possibility of physical damage.

**5.1.2.2** If the motor lead wires do not pass out of a motor directly into an acceptable raceway, or if they are brought out through the motor case, they shall pass through openings provided with an insulating bushing fastened in place.

**5.1.2.3** Terminals for a motor or for a power circuit resistor shall comply with the requirements of **5.1.3.3** to **5.1.3.5**.

### **5.1.3 *Electric Controls***

**5.1.3.1** All arcing parts in power circuits shall be enclosed or installed so as to minimize the possibility of flame or molten metal reaching surrounding combustible material on the truck.

**5.1.3.2** Reversing controllers shall be interlocked, either mechanically and/or electrically.

**5.1.3.3** Terminals and terminal construction shall be of such size and shape as to provide the necessary capacity and mechanical support for the conductors connected to them. Terminals employing a threaded screw or bolt for securing the conducting lug to a terminal plate shall provide a minimum of two full threads in the metal. All terminal nuts shall be fastened by lockwashers or equivalent means to prevent loosening of conductors.

**5.1.3.4** A base for the support of a live part shall be treated fibre, moulded-phenolic composition, sheet-phenolic composition, silicone-melamine-polyester impregnated glass-fibre laminated sheet, cold-moulded composition, treated asbestos-cement composition, or other nonabsorptive noncombustible material, evaluated in accordance with **5.1.3.5**.

**5.1.3.5** In determining the acceptability of a material other than one specifically mentioned in **5.1.3.4** for the support of a live part, consideration shall be given to its resistance to moisture, to its physical strength if it is exposed or otherwise subject to physical damage, to the means for securing it in place, and whether or not the material is so located as to be adversely affected by operation of the equipment in service-particularly by arcing. The performance of a material with respect to these properties is to be evaluated in comparison to the performance of a material given in **5.1.3.4**.

**5.1.4 Wiring** — The cables used shall be mineral insulated metal covered conforming to IS : 5755-1970\*.

**5.1.4.1** Battery leads shall comply with the requirements of **5.1.8**.

**5.1.4.2** The internal wiring of an electric truck shall consist of general use wire or appliance-wiring material of a type or types that are suitable for the particular application. This wiring shall be chosen with respect to the temperature and conditions to which the wiring may be subjected as determined during the tests prescribed in 'Indian Standard performance testing of electric battery powered industrial truck working in hazardous areas' (*under preparation*).

**NOTE** — Until the standard under preparation is published, the matter shall be subject to agreement between the concerned parties.

**5.1.4.3** Bare conductors may be insulated with insulating tubing or with noncarbonizable beads.

**5.1.4.4** A short length of rubber-insulated conductor exposed to temperatures which normally are in excess of the acceptable temperatures for the compound involved (such as to resistor terminals) is

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\*Specification for mineral insulated aluminium sheathed cables with aluminium conductors.

acceptable if supplementary heat-resistant insulation as per the requirements of dielectric withstand test of 'Indian Standard performance testing of electric battery powered industrial truck working in hazardous areas' ( *under preparation* ) is employed on the individual conductors to safeguard against failure of the insulation because of deterioration of the rubber. An insulating sleeve shall be secured in place.

**5.1.4.5** Except as given in **5.1.4.6** and **5.1.4.7** all wiring shall be protected against physical damage: (a) by enclosing it in the body of the truck; (b) by enclosing it in metal raceway, such as armoured cable, rigid metal conduit, or electrical metallic tubing; or (c) by protecting it with metal, phenolic composition, or other thermosetting material of equivalent mechanical strength and resistance to impact. The electrical wiring mounted on booms, lifts, and similar parts shall be installed so as to minimize the possibility of physical damage and kinking.

**5.1.4.6** Protection for insulated leads located within the operator's compartment is not required if the walls and floor of this compartment are of metal, phenolic composition, or other thermosetting material of equivalent mechanical strength and resistance to impact, and if the leads are not likely to be subjected to physical injury by the operator.

**5.1.4.7** Conductors connected to moving or movable parts which cannot be protected as indicated in **5.1.4.5** are to be designed for their intended use and shall satisfy the test requirements in this standard. Particular attention shall be given to resistance of conductors to damage resulting from flexing, abrasion, or impact. Flexible metal conduit may be used only for flexible connections subject to small and infrequent movements.

**5.1.4.8** Except where plug and receptacle splicing devices are used, splices in the internal wiring of the truck shall be employed only at connections to lead provided as part of components of the device.

**5.1.4.9** All the splices and connections mentioned in **5.1.4.8** shall be mechanically secure and shall provide adequate and reliable electrical contact without strain on connections and terminals. A splice shall be provided with insulation equivalent to that on the wires involved.

**5.1.4.10** A hole by means of which insulated conductors pass through a sheet-metal wall shall be provided with a smooth well-rounded bushing or shall have smooth, well-rounded surfaces upon which the insulated conductors may bear.

**5.1.4.11** Wireways shall be smooth and free from sharp edges, burrs, fins, or moving parts that can damage wiring.

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**5.1.4.12** All internal-wiring connections shall be made with solder lugs or pressure-type wire connectors, except that control wiring and other small conductors may be connected by crimped or soldered special-type lugs or eyelets.

**5.1.4.13** Terminal lugs shall be so arranged that in any position of shifting they cannot contact either the frame of the truck or other electrical circuits, or the shanks of the lugs shall be provided with insulation equivalent to that on the conductor.

**5.1.4.14** No part of the frame or enclosure of the truck shall be in electrical contact with current-carrying parts or used as a part of the electrical circuit except that, for trucks having a nominal 24-volt rating, the frame of the truck may be used as a part of the electrical circuit if the circuit is protected by an overcurrent device or disconnect switch or connector. The switch or connector shall be positive in action and readily and quickly operatable by the driver of the vehicle without leaving his normal driving position.

### **5.1.5 Overcurrent Devices**

**5.1.5.1** An overcurrent device of suitable capacity, as determined by the size necessary to prevent overheating of the smallest conductor in the circuit, shall be provided in a light, warning-signal, or other auxiliary circuit. Such a protective device may also be used in a motor-control circuit. A 1.25-mm conductor may be considered to be protected by an overcurrent device of 15 ampere rating or setting.

**5.1.5.2** The need of an overcurrent device in the power circuit is to be determined on the basis of the burnout test as given in ' Indian Standard performance testing of electric battery powered industrial truck working in hazardous areas ' ( *under preparation* ) and not by the need for protecting in the wiring against overloads of short duration. Also, an overcurrent device may be required on the basis of **5.1.4.14**.

**5.1.5.3** An overcurrent protective device provided in a control circuit in accordance with **5.1.5.1** or an overcurrent device in a power circuit provided in accordance with **5.1.5.2** is to be located as close as practicable to the battery terminals. Such a device is to be identified as to the maximum rating of the overcurrent protection to be employed, and it is recommended that it also be identified to indicate the circuit in which it is employed.

### **5.1.6 Battery Enclosure**

**5.1.6.1** The battery shall be provided with support and protection by means of a noncombustible enclosure.

**5.1.6.2** A metal cover shall have such strength and rigidity that, in conjunction with an air spacing provided between it and the battery terminals, the battery terminals are not short-circuited when a force of 12 kN/m<sup>2</sup> is applied to the cover. In lieu of the spacing, insulation designed to prevent short-circuiting of the battery terminals shall be secured to the inner surface of a metal battery-compartment cover.

### **5.1.7 Battery**

**5.1.7.1** A battery provided with a noncombustible tray and cover intended to form the ultimate enclosure for the battery shall comply with the requirements of **5.1.6**.

**5.1.7.2** The battery enclosure shall be provided with means for ventilation that minimizes the possibility of accumulation of explosive hydrogen-air mixtures above the battery.

**5.1.7.3** A battery of nominal voltage rating and representative of maximum ampere-hour capacity rating is to be supplied for the purpose of examining the truck.

**5.1.7.4** Cells employing metal containers ( such as alkaline batteries ) shall be insulated from one another and from a metal tray or metal battery compartment. Insulation of wood or other material shall be (a) treated or painted to minimize deterioration by the battery electrolyte, and (b) constructed to minimize the risk of damage to the insulation in the normal operation and maintenance of the truck.

**5.1.7.5** The connections shall be such that the potential between any two adjacent cells is not more than 24 volts ( nominal ).

**5.1.7.6** Means shall be provided as a part of the truck to restrain the battery from moving more than a total of 10 mm in a horizontal direction.

**5.1.8 Battery Leads** — Battery leads shall be of a size and current-carrying capacity adequate for the application. They shall be neoprene insulated or insulated with an equivalent material, resistant to acids and/or alkalis, and able to withstand flexing, handling, and impact at temperatures between 54°C and minus 29°C. The average insulation thickness shall be not less than 1.5 mm for a conductor from 3.15 to 6.30 mm in diameter and not less than 2 mm for a conductor from 7.10 to 11.2 mm in diameter.

### **5.1.9 Battery Plugs and Receptacles**

**5.1.9.1** Each electric truck shall be equipped with a battery connector located to provide physical protection as required for other electrical parts of the truck.

**5.1.9.2** One part of the connector shall be permanently mounted to either the truck or the battery enclosure. The length of the cable attached to the free part of the connector shall be as short as practicable, without interfering with the disconnecting operation and without placing stress on terminals.

**5.1.9.3** The live parts shall be recessed from the face of the connector to minimize the possibility of short-circuiting.

**5.1.9.4** A battery connector shall have the proper rating for use in its particular application.

**5.1.9.5** The removable portion of the connector shall be provided with means for being grasped during removal.

#### **5.1.10 Lights**

**5.1.10.1** Lampholders and lamps shall be totally enclosed.

**5.1.10.2** A lamp lens shall be protected against physical damage by bars, grids, recessing, or equivalent means.

**5.1.10.3** When bayonet-type lampholders are employed, the spacing within the lampholder between live parts of opposite polarity and between live parts and noncurrent-carrying metal parts other than the enclosure shall not be less than 2 mm measured through air or over the surface of insulating material.

**5.1.11 Horn**,— The coil and other electrical parts of an electrical horn or warning device shall be enclosed.

## **6. TYPE EE INDUSTRIAL ELECTRIC TRUCKS**

### **6.1 Construction**

**6.1.1 General** — A Type EE industrial electric truck shall comply with the following requirements in addition to those for Type E industrial trucks.

**6.1.1.1** Except as given in **5.1.4.7**, the assembly of an industrial truck shall be such as to enclose or physically protect, either individually or collectively, all wiring and other current-carrying parts.

#### **6.1.2 Motors**

**6.1.2.1** A motor shall be of the enclosed type, or shall be completely enclosed.

**6.1.2.2** If hand holes are provided in the motor enclosures, they shall be provided with metal bands to close the openings. The bands shall be not less than 0.65 mm in thickness and provided with a means, such as thumbscrew, latch, or the equivalent, for retaining the band in a closed position.



### 6.1.3 Resistors

**6.1.3.1** A resistor in the power circuit shall be provided with a substantial, flanged or equivalent, tight-fitting metal enclosure without openings for ventilation in accordance with **6.1.3.2** and **6.1.3.3**.

**6.1.3.2** An enclosure and/or enclosure cover not within the body of the truck shall be formed of not less than 3 mm thick cast metal or 6 mm thick steel plate. An enclosure located within the body of the truck may be formed of sheet metal not less than 1.3 mm thick.

**6.1.3.3** To provide an overlap as indicated in Table 1, the enclosure and/or enclosure cover shall have flanges or the equivalent for the full length of the edges.

**TABLE 1 ENCLOSURE AND/OR ENCLOSURE COVER OVERLAP**

SL No.	TYPE OF MATING SURFACE	OVERLAP	PROVISION OF GASKET	MAXIMUM SPACING OF FASTENERS
(1)	(2)	(3) mm	(4)	(5) mm
i)	Ground or machined	12	No	Not specified
ii)	Not ground or machined	12	No	150
iii)	Not ground or machined	6	Yes	Not specified

### 6.1.4 Electric Controls

**6.1.4.1** Switches, controllers, contactors, and similar arcing parts provided in the power circuit shall be housed in a flanged or equivalent tight-fitting metal enclosure without openings for ventilation in accordance with **6.1.3.1** and **6.1.3.2**.

**6.1.4.2** The switches, controllers, contactors and similar arcing parts provided in the control circuit shall be enclosed.

**6.1.4.3** A non-metallic material used to provide an enclosure in accordance with **5.1.11** or **6.1.4.2** shall be phenolic or an equivalent thermosetting material. These materials shall be considered with respect to the following properties:

- Mechanical strength,
- Resistance to impact,
- Moisture-absorptive properties,
- Combustibility, and
- Resistance to distortion at temperatures to which the material may be subjected as determined during the tests described in.

**6.1.5 Wiring** — Except as given in **5.1.4.6** and **5.1.4.7**, all wiring shall be protected against physical damage as follows:

- a) By enclosing it in the body of the truck;
- b) By enclosing it in a metal raceway, such as armoured cable, rigid metal conduit, or electrical metallic tubing; or
- c) By protecting it with metal or with either phenolic composition or other thermosetting materials of no greater combustibility than phenolic. This enclosure or protection shall prevent any flame or molten material, which may be caused by an electrical disturbance in the wiring, from reaching surrounding combustible material.

#### **6.1.6 Overcurrent Devices**

**6.1.6.1** Overcurrent devices, including fuses, provided in the power circuit, shall be housed in a flanged or equivalent, tight-fitting, metal enclosure without openings for ventilation in accordance with **6.1.3.2** and **6.1.3.3**.

**6.1.6.2** Overcurrent devices, including fuses, provided in the control circuit, shall be enclosed ( *see* **6.1.4.3** ).

#### **6.1.7 Battery Enclosure**

**6.1.7.1** The battery enclosure shall be provided with a cover with means for locking the cover in the closed position to deter opening by unauthorized persons. Insulation designed to prevent shorting of the terminals shall be secured to the inner surface of a metal enclosure over terminals.

**6.1.7.2** All upper openings shall be covered with a heavy-gauge wire mesh, expanded metal, or a perforated cover. The size and shape of the opening shall prevent passage of a rod having a diameter greater than 12 mm. If the distance between an uninsulated live part and the opening is greater than 100 mm, the opening may be large than previously mentioned, provided no opening passes a rod having a diameter greater than 20 mm.

**6.1.8 Wheels and Tyres** — All wheels shall be rubber-tyred or constructed of nonsparking material. At least two tyres and wheels shall be constructed of electrically conductive material, or some other equivalent static-discharge device, such as a conductive ground strap, shall be provided ( *see* **7.6** ).

### **7. TYPE EX INDUSTRIAL ELECTRIC TRUCKS FOR HAZARDOUS LOCATIONS**

**7.0** Type EX electric truck for use in Zone 0 shall comply with the following requirements in addition to those for Type EE industrial electric truck.

**7.1** The electric parts and wiring shall be encased in a metal enclosure capable of withstanding explosions of Zone 0 or vapour-air mixture that may occur within it, and of preventing the ignition of the gas or vapour surrounding the enclosure by sparks, flashes, or explosions of the gas or vapour within the enclosure.

**7.2 Motors** — A motor shall comply with the requirements for electric motors and generators for use in hazardous locations, Zone 0. No belt drive shall be provided with the motor unless the belts are of electrically conductive material or are enclosed in accordance with 7.1. There shall be no slippage of the belt that may cause temperature-rise which could ignite explosive atmospheres of Zone 0.

### **7.3 Battery Enclosure**

**7.3.1** The battery shall be provided with support and protection by means of a non-combustible enclosure equivalent, in strength to sheet steel not less than 5 mm thickness. The cover shall be provided with means for locking in the closed position to deter opening by unauthorized persons. Insulation designed to prevent shorting of the battery terminals shall be secured to the inner surface of a metal cover.

**7.3.2** The battery enclosure shall be provided with means for ventilation that minimizes the possibility of accumulation of explosive hydrogen-air mixtures above the battery. Ventilating openings shall be designed to prevent access to the cell terminals from the outside.

### **7.4 Battery**

**7.4.1** A suitable battery shall be provided for a Type EX truck.

**7.4.2** Ignition of the ambient gases or vapours shall be prevented by either inert gas under pressure in the battery case or by having the current-carrying parts of the battery insulated or protected against possible contact with foreign objects when cover is closed.

### **7.5 Battery Plugs and Receptacles**

**7.5.1** The 'running' plug for an electric truck shall be so interlocked with a switch that the plug can neither be inserted nor withdrawn while the receptacle contacts are live, or the plug shall be locked in its receptacle to deter removal by unauthorized persons.

**7.5.2** A receptacle used for charging purposes only shall be provided with a cover or dummy plug that is to be locked in place when the battery is not being charged to prevent access to live terminals while the equipment is in operation.

**7.5.3** A plug shall have a holding device or clamp to minimize any stresses on the plug while it is in its receptacle. A clamp shall be provided in the plug to grip the cable and minimize stress on the connection within the plug.

**7.6 Wheels and Tyres** — All wheels shall be rubber-tyred or constructed of nonsparking material. At least two tyres and wheels shall be constructed of electrically conductive material, or some other equivalent static discharge device shall be provided. Nonmetallic conductive tyres and wheels shall have a resistance of not more than 250 000 ohms when measured between the wheel hub and a metal plate on which the wheel rests.

**7.7 Safeguards Against Mechanical Sparks** — The exposed portion of metal parts given in Table 2 shall be made of or covered with medium brass, bronze, copper, or aluminium, with a hardness not more than Rockwell B66, or shall be of other material suitable for the purpose. In lieu of the exposed portion being made of, or covered with, such material, a bumper of band made of wood or such materials may be used.

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**TABLE 2 EXPOSED PORTIONS OF METAL PARTS**

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SL No.	PART	EXPOSED PORTION
(1)	(2)	(3)
i)	Truck body	Sides, rear
ii)	Tractor body	Sides, rear, front
iii)	Wheel hub*	Sides
iv)	Wheel rim*	Sides
v)	Fork:	
	a) Vertical member	Front
	b) Horizontal member	Front, sides, top, bottom
	c) Rack	Front, sides
vi)	For carriage	Ends
vii)	Barrel clamp or barrel handling attachment	Inner and outer surfaces of clamping arms, clamp support, centre spacer, and outer surfaces of clamping assembly support
viii)	Boom and hook attachment:	
	a) Vertical member	Front
	b) Horizontal member	Front, sides, top, bottom

\*Wheel hubs and wheel rims require protection only if they project beyond the body of the truck or tractor while the truck or tractor is moving in a straight line.

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## 8. MAINTENANCE OF INDUSTRIAL TRUCKS

**8.1 General** — It is essential that the fire safety built into power-operated industrial trucks be maintained; any power-operated industrial truck not in safe operating condition shall be removed from service.

### 8.2 Precautions

**8.2.1** Repairs shall not be made in hazardous areas falling under Zones 0, 1 and 2.

**8.2.2** Repairs to the electrical system of battery-powered industrial trucks shall be performed only after the battery has been disconnected.

**8.3** All parts of any industrial truck requiring replacement shall be replaced only with parts providing the same degree of fire safety as those used in the original design.

**8.4** When the temperature of any part of any truck is found to be in excess of its normal operating temperature and which creates a hazardous condition, the vehicle shall be removed from service and not returned to service until the cause for such overheating has been eliminated.

**8.5** Industrial trucks shall be kept in a clean condition, reasonably free of lint, excess oil, and grease. Noncombustible agents are preferred for cleaning trucks. Precautions regarding toxicity, ventilation, and fire hazard shall be in consonance with the agent or solvent used.

## 9. MARKING

### 9.1 Type E Industrial Electric Trucks

**9.1.1** A Type E industrial electric truck shall be marked with the following where the markings will be visible:

- a) Name or trade-mark of the manufacturer;
- b) Type designation ( Type E );
- c) Catalogue designation or equivalent identification;
- d) Battery nominal voltage and maximum ampere-hour capacity at five hour rate. If the battery is not furnished with the truck by the truck manufacturer, the truck shall be marked with the names of the manufacturers of the recommended batteries and the catalogue designations or equivalent battery identification in such location that the marking is readily visible. Such equivalent identification may be a reference to the construction requirements in this standard for the battery intended to be used with the truck;

- e) Maximum rated load in kg, including type and position of loading, as follows:
  - i) Platform or pallet trucks ( low lift and nonelevating ) — load rating in kg, with load centre near the centre of the load engaging means.
  - ii) Platform trucks ( high lift ) — load rating in kg, at a specified load centre that the truck can transport and stack to a height established by the truck manufacturer.
  - iii) Forklift trucks — load hauling rating in kg lift height, and location of load centre in mm from vertical surface of forks when in a vertical plane.
  - iv) Tractors — drawbar pull in Newtons.
  - v) Combination trucks — the appropriate combination of ratings as required for two or more of the foregoing types.
- f) Replacement fuse size located on or adjacent to fuseholders.

**9.1.1.1** A battery for use with a Type E industrial electric truck shall be marked with the battery nominal voltage, ampere-hour capacity, battery manufacturer's name, and the catalogue designation or equivalent identification.

**9.1.1.2** A schematic or pictorial circuit wiring diagram shall be furnished with each truck.

## **9.2 Type EE Industrial Electric Trucks**

**9.2.1** Each Type EE industrial electric truck shall be marked where the markings are visible with the following:

- a) Name or trade-mark of the manufacturer;
- b) Type designation ( Type EE );
- c) Catalogue designation or equivalent identification;
- d) Battery nominal voltage and maximum ampere-hour capacity at five hour rate. If the battery is not furnished with the truck by the truck manufacturer, the truck shall be marked with the names of the recommended batteries and the catalogue designations or equivalent identification in such location that the marking is readily visible. Such equivalent identification may be a reference to the construction requirements in this standard for the battery intended to be used with the truck;
- e) Maximum rated load in kg, including type and position of loading [ see 9.1.1 (e) ]; and
- f) Replacement fuse size located on or adjacent to fuseholders.

**9.2.1.1** A battery for use with a Type EE industrial electric truck shall be marked with the battery nominal voltage, ampere-hour capacity, battery manufacturer's name, and the catalogue designation or equivalent identification.

**9.2.1.2** A schematic or pictorial circuit wiring diagram shall be furnished with each truck.

### **9.3 Type EX Industrial Electric Trucks for Hazardous Locations**

**9.3.1** A Type EX industrial truck for hazardous location, shall be marked where the markings are visible with the following:

- a) Name or trade-mark of the manufacturer;
- b) Type designation ( Type EX );
- c) Class and group of the hazardous location in which the truck is intended to be used;
- d) A statement calling attention to the necessity for keeping enclosures of electrical parts and wiring tightly assembled while in hazardous area;
- e) Catalogue designation or equivalent identification;
- f) Nominal voltage rating of the battery;
- g) Maximum rated load in kg, including the type and position of the loading [ *see 9.1.1 (e)* ].

**9.3.1.1** A schematic or pictorial circuit wiring diagram shall be furnished with each truck.